

# **Exhibit A**

## JOHN L. GUSTAFSON

### EDUCATION

- B.S. (June 1977) in Applied Mathematics, with Honors  
California Institute of Technology, Pasadena, California, P. G. Saffman, advisor  
Applied Physics second major 1973–1976, J. R. Pierce, advisor
- M.S. (June 1981) in Applied Mathematics  
Iowa State University, Ames, Iowa  
Thesis: “Total Positivity of Hypergeometric Functions,” B. C. Carlson, advisor
- Ph.D. (August 1982) in Applied Mathematics  
Iowa State University, Ames, Iowa  
Dissertation: “Asymptotic Expansions of Elliptic Integrals,” B. C. Carlson, advisor

### PROFESSIONAL EXPERIENCE

- 11/21 to present: **Visiting Scholar, Arizona State University**  
Collaborate with other faculty and students at ASU on research using novel number formats, with a particular focus on simulation of quantum computers. Deliver guest lectures on high-performance computing.
- 6/21 to present: **Consultant, SambaNova Systems Inc.**  
Analyze and eliminate sources of rounding error in low-precision, high dynamic range arithmetic. Create math library algorithms for higher-precision elementary functions.
- 8/15 to 11/21: **Professor, National University of Singapore (Joint appointment with A\*STAR)**  
Conduct research on next-generation computer arithmetic (unums and posits). Teach advanced computer architecture and parallel computing at undergraduate and graduate levels at NUS. Advise graduate students. Generate publications regarding computer arithmetic and deliver keynote presentations on the subject at conferences. Form a virtual collaboration team worldwide to explore chip-level hardware, languages and compilers, automatic accuracy control and other tools, and applications where the new format improves accuracy and ease-of-use while decreasing storage, bandwidth demands, energy use, and power consumption.
- 6/15 to present: **Chief Scientist, Etaphase**  
Direct DARPA-funded research into the use of novel computer arithmetic formats for massive multi-physics simulations. Apply results to the creation of a compact million-volt power supply for neutron generation.
- 11/13 to present: **CTO / Chief Scientist, Ceranovo Inc., later renamed Vq Research Inc.**  
Responsible for overseeing all technical aspects of company, establishing technical vision, strategic direction, development, and future growth. Provide leadership to support the company’s culture, mission, and values, conduct research and case studies on leading edge technologies and make determinations of the probability of implementation; act as a good steward of the company’s resources and ensure control of technology budgets.
- 6/13 to 11/13: **Consultant to MPT and author for CRC Press**  
Assist Massively Parallel Technologies with the completion and productization of their collaborative cloud software development platform. Complete book on a new form of high-efficiency numerical computing for CRC Press, published February 2015.

- 8/12 to 6/13: **Senior Fellow, Chief Product Architect, AMD, Sunnyvale, CA**  
 Serve as technical lead for AMD's Graphics Processor Unit division. Evangelize AMD's graphics and high-performance computing approaches externally and internally; manage product road map; provide vision for future computing architectures to allow AMD to remain competitive.
- 3/09 to 8/12: **Director, Intel Labs, Santa Clara, CA**  
 Directed an organization with about 50 researchers, mostly PhDs, working in a variety of areas. Funded and managed many university partners as well. The directorate was called XTL, for "eXtreme Technologies Lab," and was the part of Intel's research that is the most radical and visionary. The portfolio included energy-efficient computing and memory, for which we used FPGA-based emulators and software simulators as well as silicon prototyping; novel electrical energy storage approaches; free-space optics communications for consumer and data center applications; low-latency massively parallel computing operating systems; and new ways to represent real numbers for higher accuracy but lower bandwidth, energy, and storage requirements.  
 Directed Intel's participation in the \$49 million DARPA Ubiquitous High-Performance Computing (UHPC) program, which in a way is a successor to the DARPA HPCS program John directed at Sun Microsystems. Lab budget was around \$30 million per year.  
 Filed about two patents per year, including two with over 40 sub-claims. Appointed to the Intel Patent Council that reviews the patent submissions from Intel employees. Awarded numerous awards within Intel for venturing efforts and solution of organizational problems.
- 3/09 to present: **Member, Board of Directors, Massively Parallel Technology Inc.** Position held concurrently with Director position at Intel and Senior Fellow position at AMD.
- 5/08 to 3/09: **Chief Executive Officer, Massively Parallel Technology Inc.** MPT is a privately held parallel computing company that was initially funded by the DARPA HPCS program (the same one that funded Cray, Sun, and IBM); it is now applying the patented IP it generated during that phase to the creation of firmware/hardware product lines that allow HPC clusters to scale to thousands of processors on a single problem. Its initial products will resemble network accelerators.
- 9/05 to 5/08: **Chief Technology Officer, ClearSpeed Technology Inc.** Responsible for technology of a 130-employee high-performance computing company with a \$100+ million market capitalization. Identify and communicate present and future HPC requirements to company; serve as technical point of contact for strategic partners; identify gaps in current solution set and propose solutions; serve as spokesman to the HPC community; provide engineering with product guidance, wish lists, and help set priorities. Provide sales and marketing with analysis of algorithm-architecture fit. Develop and deliver demonstrations, prototypes, solutions, and proof-points. Create external technical papers and presentations. Create internal technical analyses for both executives and engineering.
- 9/04 to 9/05: Principal Engineer, Sun Labs. Application Architect for Sun's High-Performance Computing Systems (DARPA HPCS) program.
- 4/04 to 9/04: Chief Technology Officer, ECS Inc. Responsible for technology direction and portfolio for a startup computing integrator, Enterprise Cluster Solutions, Inc.
- 7/02 to 4/04: Scientist, Sun Labs. Responsible for defining High-Performance Computing (HPC) workloads for use in system measurement and analysis framework. Created novel benchmark approaches both for general Sun use and for Phase I of the DARPA High-Productivity Computing Systems (HPCS) program. Team lead for HPCS software as of 2/03; HPCS Principal Investigator as of 4/03 responsible for creation of Phase II proposal. Became Application Architecture Team Leader for HPCS Phase II.
- 3/00 to 7/02: Senior Manager, Market Development Engineering, Sun Microsystems. Responsible for engineering relationship between Sun and technical Independent Software Vendors (ISVs). Managed many direct reports and multiple interdepartmental projects involving benchmarking, porting, tuning, debugging, and scaling of ISV codes. Created and managed company-wide program for improving Sun product performance on the most commercially-significant ISV codes.
- 10/98 to 7/99: Director of Ames Operations, Colorado MEDtech. Responsible for developing software business unit for medical software engineering.

- 8/89 to 10/98: Computational Scientist, Ames Laboratory. Founder and Principal Investigator for the Scalable Computing Laboratory, performing research on advanced computer architectures, with attention to materials science, chemistry, physics, and graphics applications.  
Adjunct Associate Professor, Iowa State University, Department of Computer Science, Department of Mathematics.
- 8/87 to 8/89: Member of the Technical Staff, Sandia National Laboratories. Developed applications for massively parallel computers and analyzed performance. Proposed and published new directions for high-speed computing.
- 10/86 to 8/87: Staff Scientist, nCUBE. Analyzed hypercube computer architecture and application fit for scientific customers, engineers, and marketing/sales.
- 8/82 to 10/86: Senior Staff Scientist and Product Development Manager, Floating Point Systems, Inc. Directed development of ECL- and VLSI-based scientific computers for target markets; acted as liaison between Engineering and Marketing; managed group that planned and executed product introductions.
- 2/78 to 8/82: Software Reliability Engineer, Jet Propulsion Laboratory in Pasadena. Enforced top-down software development process for the Deep Space Net.

## **PATENTS (629 CLAIMS GRANTED TO DATE)**

- 29. Methods and systems to improve printed electrical components and for integration in circuits, US10685892B2. 20 claims. Granted June 16, 2020.
- 28. Methods and systems to improve printed electrical components and for integration in circuits, US10431508B2. 15 claims. Granted October 1, 2019.
- 27. Methods and systems for material cladding of multilayer ceramic capacitors, US 10,332,684). 2 claims. Granted June 25, 2019.
- 26. Methods and systems for geometric optimization of multilayer ceramic capacitors, US10242803B2. 12 claims. Granted March 26, 2019.
- 25. Methods and systems to minimize delamination of multilayer ceramic capacitors, US10236123B2. 7 claims. Granted March 19, 2019.
- 24. Fabrication of porous silicon electrochemical capacitors, US20140233152A1. 71 claims. Granted January 1, 2019.
- 23. Methods and systems for increasing surface area of multilayer ceramic capacitors, US10128047B2. 4 claims. Granted November 13, 2018.
- 22. Overcoming variance in stacked capacitors, US10014123B2. 9 claims. Granted July 3, 2018.
- 21. Energy storage device, method of manufacturing same, and mobile electronic device containing same, US20150049414A1. 23 claims. Granted May 22, 2018.
- 20. Energy storage device, method of manufacturing same, and mobile electronic device containing same, US9978533B2. 13 claims. Granted May 22, 2018.
- 19. Energy storage structure, method of manufacturing a support structure for same, and microelectronic assembly and system containing same, US9409767B2. 10 claims. Granted August 9, 2016.
- 18. Charge storage device, method of making same, method of making an electrically conductive structure for same, mobile electronic device using same, and microelectronic device containing same, US9368290B2. 18 claims. Granted June 14, 2016.
- 17. Overcoming variance in stacked capacitors, US20140036412A1. 30 claims. Granted March 29, 2016.
- 16. Overcoming variance in stacked capacitors, US9299505B2. 20 claims. Granted Mar. 16, 2016.
- 15. Energy storage structure, method of manufacturing a support structure for same, and microelectronic assembly and system containing same, US20130279137A1. 24 claims. Granted August 9, 2016.



14. Integration of energy storage devices onto substrates for microelectronics and mobile devices US9245695B2. 34 claims. Published Jan. 26, 2016.
13. Integration of energy storage devices onto substrates for microelectronics and mobile devices, US20140226260A1. 35 claims. Granted January 26, 2016.
12. Number representation and memory system for arithmetic, US9223544B2. 36 claims. Granted Dec. 29, 2015.
11. Method and apparatus for bezel mitigation with head tracking, US20150370322A1. 20 claims. Published December 24, 2015.
10. Charge storage device, method of making same, method of making an electrically conductive structure for same, mobile electronic device using same, and microelectronic device containing same, (US9013861B2). 21 claims. Granted April 21, 2015.
9. Method of increasing an energy density and an achievable power output of an energy storage device, EP2761636A1 A1. 57 claims. Published August 6, 2014.
8. Method of increasing energy density and an achievable power output of an energy storage device, US 20130273261A1. 29 claims. Published October 17, 2013.
7. Rack to rack optical communication, US20120155885A1. 19 claims. Published June 21, 2012.
6. High-efficiency illumination, WO2012040668 A2. 18 claims. Published March 29, 2012.
5. Method and apparatus for accuracy-aware analysis (US7448026B1). 20 claims. Granted November 4, 2008
4. Precision improvement method for the Strassen/Winograd matrix multiplication method (US7209939B2). 11 claims. Granted April 24, 2007.
3. Methods for operating parallel computing systems employing sequenced communications (US5935216A). 23 claims. Granted August 10, 1999.
2. Method and system for benchmarking computers (US5245638). 19 claims. Granted September 14, 1993.
1. Method for simultaneous overlapped communications between neighboring processors (US5072371). 9 claims. Granted December 10, 1991.

## HONORS AND AWARDS

2019 Induction into the TRHS Hall of Fame  
 2018 Quora Top Writer 2018  
 2011 Atanasoff Achievement Award, Iowa State University  
 2007 Election to IEEE Golden Core (highest membership level)  
 2006 Inaugural IEEE International Atanasoff Award  
 2000 Iowa State University Inventor of the Year Award  
 1998 Distinguished Visiting Professor, New Mexico State University  
 1997 PDPTA Outstanding Achievement Award  
 1995 R&D 100 Award  
 1991 R&D 100 Award  
 1990 New Mexico Inventor of the Year Award  
 1989 R&D 100 Award  
 1988 Parallel computing breakthrough read into U.S. Congressional Record  
 1988 Gordon Bell Award (Greatest annual contribution to the science of parallel processing)  
 1988 Karp Challenge (First demonstration of parallel speedup of over 200 times)  
 1977 Richter Fellowship  
 1977 Graduation with Honors, Election to Gnome Club (Caltech honor society)  
 1974 Eric Temple Bell Award (Caltech; for "Outstanding Original Research in Mathematics")  
 1973 Drake Physics Prize

## MAJOR ACCOMPLISHMENTS

2019: Solved the centuries-old “Table-Maker’s Dilemma” for evaluating transcendental functions numerically with perfect rounding for all inputs, at high and consistent speed. Developed specific routines for exponential, logarithmic, and trigonometric functions executing around 100 million results per second on current individual x86 core processors.

2017: Invented the “posit” number format as a drop-in replacement for IEEE 754 Standard floating-point arithmetic (floats); posits round like floats but cannot overflow or underflow, and they simultaneously increase both accuracy and dynamic range while giving repeatable and portable results, unlike floats. Commercialization efforts began immediately following public presentation on February 2, 2017.

2013: Created new universal number (“unum”) format for computation for superior answers with less storage and energy cost, eliminating rounding error, overflow, and underflow. Used it to solve long-standing mathematical challenges, such as bounded solutions for the  $n$ -body problem, lossless evaluation of polynomials, and deterministic evaluation of the power function. Basis for book “The End of Error: Unum Computation” that has received accolades as being possibly the future of computing; book was #1 best-seller in its Amazon category (over 4,000 titles in that category).

2012: Created and led a Technology Strategic Long-Range Plan (TSLRP) at Intel, selected from 198 entries, proposing a new direction for high-efficiency floating-point arithmetic. Obtained strong endorsement from Intel C-level executives, and the senior VPs of Intel Architecture and the Software and Systems Group.

2010: Created and led an initiative in novel silicon-based energy storage at Intel; received special funding from the CEO and CTO and presented to the Board of Directors in 2011. Basis for five patent applications to the US Patent Office in 2011, containing a total of 340 claims (almost one new claim per day).

2006: Doubled the speed of ClearSpeed’s accelerator product by inventing a fundamental change to its microcode, restoring the company’s competitive position pending its next chip generation.

2003: Created software approach for HPCS that resolved competing requirements of massive parallelism, high programmer productivity, and support for legacy environments; used persistent file concept in combination with novel benchmark approach to show feasibility of letting computer offload human burden of parallel programming. Invented and prototyped an accuracy-aware debugging environment (AADE) to increase productivity by automating numerical analysis and detecting causes of accuracy loss. Created successful HPCS Phase II proposal, with \$47 million funding from DARPA for Sun’s petascale computing R&D.

2002: Invented Purpose-Based Benchmark (PBB) approach, solving several long-standing problems in defining representative workloads for technical/scientific computing. PBBs were embraced by DARPA and required for all vendors in Phase II as the method of measuring productivity. Created reference implementation of first PBB.

2001–2002: Initiated, designed, and executed Sun’s “Tunathon II” program for the improvement of commercial software application performance on Sun platforms through company-wide collaborations. Chaired the oversight committee, set performance rules, coordinated submissions with Legal and Marketing departments, and awarded Sun employee bonuses based on performance gains achieved and delivered to customers.

2000: Rebuilt the HPC/EDA Market Development Engineering group at Sun Microsystems, Inc., creating effective coverage of Sun’s \$3 billion market share.

1996–1998: Completed a working replica of the historic (1939–1942) Atanasoff-Berry Computer built at Iowa State College. Demonstrated it for a national audience, ending a long-standing debate over who had invented the first electronic digital computer. Created publicity material, including World Wide Web site.

1993–1995: Created first computer program (PHOTON) to solve the Kajiya Rendering Equation for global illumination; PHOTON scales to any desired precision and runs on any number of distributed-memory processors. Unlike most graphics rendering programs, PHOTON produces physically correct light intensities and is not restricted to particular surface types.

1991–95: Created first broad-spectrum computer benchmarks (SLALOM and HINT) capable of fair comparison despite different memory sizes, precisions, architectures, and languages. The network version of HINT, “NetPIPE,” is still in widespread use for communication benchmarking and is part of many Linux distributions.

1989–92: Founded and grew the Scalable Computing Laboratory to \$3 million annual budget within Ames Laboratory. Amassed collection of supercomputers from commercially healthy vendors that is a university resource for research and education.

1988: Attained 14x Cray X-MP speed on a production radar simulation program, using a 1024-processor system. Improved cost-performance over existing methods by over 100x.

1987: Obtained unprecedented speedup (1020x) on 1024-processor system, for practical scientific programs, resulting in widespread industry adoption of massively parallel computing approaches. Developed scaled speedup concepts (including an alternative to Amdahl's law that predicts only limited parallel speedup, now recognized as "Gustafson's law"). Extended ideas to vector-parallel architectures. Created a suite of techniques for achieving high parallel efficiency.

1985: Championed the FPS "Tesseract," a radically parallel vector computer. First to suggest that future supercomputer systems would be room-filling clusters of racked commodity systems with message-passing parallelism. Defined hardware specifications, program development software, application software, and position with respect to other FPS products. Created and executed product introduction plan, created collateral material, and supported first installations.

1985: Participated in algorithmic and hardware design of the FPS-164/MAX, a scientific computer tailored to the matrix-intensive computations of the structural analysis and computational chemistry marketplaces. Served primary role in pricing, press tours, sales force education, and software functional specifications for the product.

1985: Created the first "Level 3" version of the Basic Linear Algebra Subroutines (BLAS), now the basis of LAPACK, ATLAS, and the modern LINPACK benchmark. Showed Jack Dongarra how to make LINPACK scalable and flexible enough to benchmark massively parallel computers, enabling what we now know as the TOP500 list.

1985: Planned and executed the introduction of the FPS-264, the first ECL computer produced by Floating Point Systems. Assembled strategy for the construction of Class VII computer facilities using clusters of that computer, applied successfully to four sites including the NSF Supercomputer Center at Cornell.

1983: Developed automatic source code analyzer for finding high-level post-compilation errors in JPL programs. Increased speed and thoroughness of efforts to prove program correctness.

1982–1997: Created a software company, Parallel Solutions, that generated about \$250,000 in revenue for a 375-routine math library (150,000 lines of hand-tuned assembly language), real-time commodity trading, symbolic algebra, 3-dimensional plotting, structural beam analysis, insurance underwriting, and blood lipoprotein analysis, either on contract or for commercial sale.

## EDITORIAL/ CONFERENCE RESPONSIBILITIES

General Chair, *Conference for Next-Generation Arithmetic (CoNGA)*, 2018, 2019, 2021, and 2022.

Organizing Committee and Scientific Committee, *Supercomputing Frontiers*, (2016, 2017)

External Advisory Board, Iowa State University Computer Science Dept. and Software Engineering Dept., (2009 –)

Subcommittee Chairman for Performance Evaluation, *Supercomputing 2008*

Program Committee, *IPDPS 2007*

Steering Committee and Program Committee, International Atanasoff Symposium (2006)

Program Committee, *Supercomputing* conferences (1991, 1993, 1995, 1998, 2003, 2005)

Editorial Board, *International Journal on High Performance Computing and Networking*, (2004)

Program Committee, *PDPTA* (1998)

Program Committee, *International Parallel Processing Symposium* (1995, 1996, 1997)

Applications Chair, *International Parallel Processing Symposium* (1996)

Subject Area Editor, *Journal of Parallel and Distributed Computing* (1990 – 1998)

Editorial Board, *Parallel and Distributed Computer Practices* (1997 –)

Editorial Advisory Board, *Scientific Programming* (1994 –)

Judge, *R&D 100 Awards* (1992, 1993, 1994, 1996, 1997)

Judge, *Mannheim SuParCup Awards* (1993, 1994, 1995)

Program Committee, *PERMEAN* (1995)

Program Committee, *Frontiers of Massively Parallel Computation* (1992)

Program Chair, *Fourth Conference on Hypercubes, Concurrent Computers, and Applications* (1989)



## DEPARTMENT OF ENERGY AND DARPA GRANTS (8)

Unum arithmetic for linear algebra, DARPA TRADES program: **\$300,000 over two years**, January 2017 to December 2018. Co-authored proposal and created the idea for exploration. With Etaphase, Inc.

Sun's Phase II participation in the DARPA HPCS program: **\$47,000,000 over three years**, plus matching funds from Sun. Author of the proposal that moved Sun from last place (of IBM, Cray, HP, SGI, and Sun) to first place (tied with IBM) in the down-select from Phase I.

Funding of the Scalable Computing Laboratory ranged from **\$1,000,000 to \$3,000,000 per year**, 1989–1999, and was dependent on an annual proposal to the DOE for research and development to be performed and its approval.

"Parallelization Agent for Legacy Codes in Environmental Modeling," **\$484,382** for 1996–1999. With Suraj Kothari (Computer Science) and Eugene Takle (Atmospheric Science). *Environmental Protection Agency*, #EPA/600/F-95/017.

"High Performance Morphological Filtering of Cirrus Emission from Infrared Images," **\$90,000** for 1993–1996. With John Basart (Electrical Engineering), Philip Appleton (Physics/Astronomy), and Jeffrey Pedelty (NASA/Goddard Space Flight Center). *NASA*, NRA-92-OSSA-2

"A Massively Parallel Global Mesoscale Model with Improved Surface-Layer Coupling," with Eugene Takle, **\$90,000** for 1993–1996, *NASA High Performance Computing & Communications Program*.

"Performance Evaluation: Massively Parallel Computers," **\$1,459,000** for 1988–1990. Lead investigator, with Robert Benner, Gilbert Weigand, and Guylaine Pollock (Sandia National Laboratories). Supplemental Research Proposal to Scientific Computing Staff, *Office of Energy Research, USDOE*.

The MasPar MP-2 at the Scalable Computing Laboratory was funded through an agreement with the Center for Non-Destructive Evaluation. **\$100,000**, 1992.

## BOOKS (1)

- B2015.1 J. Gustafson, *The End of Error: Unum Computing*, Chapman & Hall/CRC Computational Science Series, ISBN 1482239868, 432 pages, February 2015. See [http://www.amazon.com/End-Error-Computing-Chapman-Computational/dp/1482239868/ref=sr\\_1\\_1](http://www.amazon.com/End-Error-Computing-Chapman-Computational/dp/1482239868/ref=sr_1_1)

## TECHNICAL REPORTS AND ON-LINE PUBLICATIONS (27)

- T2007.4 J. Gustafson, "A Study of Accelerator Options for Maximizing Cluster Performance," ClearSpeed white paper, August 2007.
- T2007.3 J. Gustafson, "Algorithm Leadership," *HPCWire* contributed article, April 2007. Online at <http://www.clearspeed.com/docs/resources/Gustafson-ISC2007.pdf>
- T2007.2 J. Gustafson, "Escaping the Shackles of 20<sup>th</sup>-Century Computing," ClearSpeed presentation at ISC2007, Dresden, Germany, April 2007. Online at <http://www.hpcwire.com/hpc/1347145.html>
- T2007.1 J. Gustafson, "Latency, Bandwidth, and Accelerators," ClearSpeed white paper, February 2007. Online at <http://www.clearspeed.com/docs/resources/LatencyBandwidthPaper.pdf>
- T2006.3 J. Gustafson, "Understanding the Different Acceleration Technologies," ClearSpeed white paper, presented at SC'06. Online at <http://www.hpcwire.com/hpc/1091512.html>
- T2006.2 J. Gustafson, "The New Limits on High Performance Computing," *HPCWire* contributed article, <http://www.hpcwire.com/hpc/705814.html>
- T2006.1 J. Gustafson and B. Greer (Intel), "ClearSpeed Advance: A Hardware Accelerator for the Intel Math Library," March 2006. Online at [http://www.clearspeed.com/docs/resources/ClearSpeed\\_Intel\\_Whitepaper\\_Mar07.pdf](http://www.clearspeed.com/docs/resources/ClearSpeed_Intel_Whitepaper_Mar07.pdf)
- T2005.1 Tim Curns, Editor, "Sun's Gustafson on Envisioning HPC Roadmaps for the Future," Online interview at <http://www.hpcwire.com/hpcwire/hpcwireWWW/05/0114/109060.html>
- T1996.1 Alan Beck, Managing Editor, "Developer Details Advantages of HINT Benchmark." Online interview at <http://www.hpcwire.com/archives/8569.html>
- T1995.1 J. Gustafson and M. Wikstrom, "A New Paradigm for Computer Users," *Ames Laboratory Technical Report IS-5119, UC-32*, July 1995. Online at <http://www.scl.ameslab.gov/Publications/Gus/NewParadigm/NewParadigm.html>
- T1994.1 J. Gustafson and Q. Snell, "HINT: A New Way to Measure Computer Performance," *Ames Laboratory Technical Report IS-5109, UC-405*, August 1994. Online at <http://www.scl.ameslab.gov/Publications/Gus/HINT/HINTAcrobat.pdf>
- T1993.2 M. Carter and J. Gustafson, "An Improved Hierarchical Radiosity Method," *Ames Laboratory Technical Report IS-J 4881*, January 1993.



- T1993.1 M. Carter and J. Gustafson, "The Symmetric Radiosity Formulation," *Ames Laboratory Technical Report IS-J 4880*, January 1993.
- T1992.1 J. Gustafson and S. Aluru, "Massively Parallel Searching for Better Algorithms, or How to do a Cross Product with Five Multiplications," *Ames Laboratory Technical Report IS-5088, UC-32*, December 1992. Online at <http://www.scl.ameslab.gov/Publications/Gus/FiveMultiplications/Five.html>
- T1991.3 M. Wikstrom, G. Prabhu, and J. Gustafson, "A Meta-Balancer for Dynamic Load Balancers," *Ames Laboratory Technical Report TR 91-04*, January 1991.
- T1991.2 M. Wikstrom, G. Prabhu, and J. Gustafson, "The Work/Exchange Model," *Ames Laboratory Technical Report TR 91-03*, January 1991.
- T1991.1 X. -H. Sun and J. Gustafson, "Toward a Better Parallel Performance Metric," *Ames Laboratory Technical Report IS-5049, UC-32*, January 1991.
- T1990.1 J. Gustafson, D. Rover, S. Elbert, and M. Carter, "The Design of a Scalable, Fixed Time Computer Benchmark," *Ames Laboratory Technical Report IS-5049, UC-32*, April 1990.
- T1988.2 J. Gustafson, "A Performance Model for Massive Parallelism," SAND Report SAND88-1281, April 1988.
- T1988.1 J. Gustafson, G. Montry, and R. Benner, "Development and Analysis of Scientific Application Programs on a 1024-Processor Hypercube," SAND Report, March 1988.
- T1986.2 J. Gustafson, "Programming the FPS T Series," *Checkpoint*, June 1986.
- T1986.1 J. Gustafson, "Parallel Processing using Multiple FPS Scientific Computers," *Checkpoint*, January 1986.
- T1985.2 J. Gustafson, "First Electronic Digital Calculating Machine Forerunner to Cornell's FPS-164/MAX," *Forefronts*, Cornell University Theory Center publication, October 1985.
- T1985.1 J. Gustafson, "The Measurement of Floating-Point Operations per Second," August 1985.
- T1984.1 J. Gustafson, "A Comparison of the FPS-264 and FPS-164," *Checkpoint*, August 1984.
- T1983.1 J. Gustafson, "Matrix Multiplication on the FPS-164," *Application Note*, Floating Point Systems, May 1983.
- T1982.1 J. Gustafson and B. Greer, "Solving Tridiagonal Systems on the FPS-164," *Application Note*, Floating Point Systems publication, November 1982.

## INVITED DEBATE

"The Great Debate: John Gustafson vs. William Kahan," special event at *ARITH 23*, San Jose CA, Jul. 21, 2016. Posted online at <http://arith23.gforge.inria.fr/program.html>. Transcription available at <http://www.johngustafson.net/pdfs/DebateTranscription.pdf>.

## INVITED KEYNOTE LECTURES (61)

- K2022.1 "An HPC Watershed: Next-Generation Arithmetic," *ASU HPC Research Computing Expo*, Tempe AZ, August 1, 2022.
- K2021.2 "Emerging Alternatives to IEEE Floating-Point," McMaster University, October 26, 2021.
- K2021.1 "Recent Breakthroughs in Next-Generation Arithmetic," *Supercomputing Asia (SCAsia 2021)*, Online Virtual Conference, March 3, 2021.
- K2019.2 "Posits and Quires: Freeing Programmers from Mixed-Precision Decisions," *International Supercomputing Conference 2019*, Frankfurt, Germany Jun. 18, 2019.
- K2019.1 "Perfect Math Libraries Without Sacrificing Speed: The Minefield Method," *Multicore World 2019*, Wellington, New Zealand, Feb. 13, 2019.
- K2018.1 "Irreproducibility: The Causes and the Cure," *Multicore World 2018*, Wellington, New Zealand, Feb. 7, 2018.
- K2017.3 "Weapons of Math Destruction: Floating Point and How to Fix It," *Friday Hacks*, (NUS Hacker's Club speaker series), Singapore, March 17, 2017.
- K2017.2 "Beating Floating Point at its Own Game," *Supercomputing Frontiers 2017*, Singapore, March 16, 2017.
- K2017.1 "The Coming Revolution in How Computers Calculate," *EmTech Asia 2017*, Singapore, February 14, 2017.
- K2016.11 "Beyond Floating Point: Next-Generation Computer Arithmetic," Stanford University EE380 Seminar Series, USA, February 1, 2017. <http://ee.stanford.edu/event/seminar/beyond-floating-point-next-generation-computer-arithmetic-ee380> and viewable at <https://www.youtube.com/watch?v=aPOY1uAA-2Y>.
- K2016.10 "Technology Disruptions and Opportunities," *HPC Startups*, part of *Supercomputing 2016*, November 14, 2016.
- K2016.9 "Unum Systems for Better Computational Arithmetic," *1st Annual CROSS Research Symposium*, UC Santa Cruz, USA, October 25, 2016.
- K2016.8 "Unum Arithmetic Research at A\*STAR Computer Research Centre," *International Workshop on HPC Architecture, Software, and Applications at an Extreme Scale*, Wuxi Supercomputer Centre, China, September 17, 2016.
- K2016.7 "Two Epic Disruptions in the Computer Industry: One in the 1980s and One Happening Now," *SMU Speaker Series*, Singapore, September 15, 2016.

- K2016.6 "A Radical Approach to Computing with Real Numbers" (updated), *Numerical Computations, Theory and Algorithms (NUMTA 2016)*, Pizzo Calabro, Italy, Jun. 20, 2016.
- K2016.5 "Maximizing Information per Bit: A New Approach to the Design of Numerical Computing Systems," seminar at Pawsey Supercomputer Centre, Perth, Australia, June 3, 2016.
- K2016.4 "An Energy-Efficient and Massively Parallel Approach to Valid Numerics," seminar at the International Centre for Radio Astronomy (ICRAR), Perth, Australia, Jun 2, 2016.
- K2016.3 "A Radical Approach to Computing with Real Numbers" (updated), *Supercomputing Frontiers 2016*, Singapore, Mar. 17, 2016
- K2016.2 "Unums Implementations," *Multicore World 2016*, Wellington, New Zealand, Feb. 17, 2015.
- K2016.1 "A Radical Approach to Computing with Real Numbers," *Multicore World 2016*, Wellington, New Zealand, Feb. 16, 2015.
- K2015.1 "Toward an Open Software Stack for Exascale Computing," *Supercomputing 2015*, Austin, TX, Nov. 19, 2015.
- K2013.1 "A New Number Format: The Unum," *TTI Vanguard [next] Series*, December 10, 2013
- K2009.1 "Future Clusters," *IEEE Cluster 2009*, September 1, 2009.
- K2007.5 "Predicting ClearSpeed Acceleration for Real Applications," Halmstead University (Sweden), May 31, 2007.
- K2007.4 "Computing by the Liter," *HPC Asia*, Seoul, Korea, September 10, 2007.
- K2007.3 "64-Bit Floating-Point Accelerators for HPC Applications," *Louisiana State University Computer Science Lecture Series*, September 5, 2007.
- K2007.2 "Requirements for Successful Use of Accelerators," *Bay Area Beowulf Users Group (BayBUG)*, February 20, 2007.
- K2007.1 "Acceleration Technologies: Fit for Purpose," *Hybrid Computing Conference*, Salt Lake City UT, January 31, 2007.
- K2006.1 "The Quest for Linear Solvers and the Invention of Electronic Digital Computing," *JVA 2006 International Symposium on Computing*, Sofia, Bulgaria, October 2006.
- K2004.2 "The Speed of Light Isn't What It Used to Be," *Tenth International Conference on Parallel and Distributed Systems (ICPADS 2004)*, July 2004.
- K2004.1 "The New Parallel Processing Challenge: Watts," *Workshop on OpenMP Applications and Tools (WOMPAT)*, Houston, Texas, May 17, 2004.
- K2003.1 "Sun's HPCS Approach: Hero," *Center for Advanced Scientific Computing (CASC) Conference*, Berkeley, California, August 7, 2003. Online at <http://www.casc.org/meetings/CASC2.pdf>
- K2002.2 "Workload Benchmarks that Scale in Multiple Dimensions," *Fifth Workshop on Workload Characterization*, Austin, Texas, November 25, 2002.
- K2002.1 "The Cost of the Single System Image," *International Conference on Parallel Processing*, Vancouver, British Columbia, August 2002.
- K2000.1 "The Mainstreaming of Interval Arithmetic," *SCAN 2000*, Karlsruhe, Germany, September 2000.
- K1999.1 "Conventional Benchmarks as a Sample of the Performance Spectrum," *Workshop on Performance Evaluation with Realistic Applications*, San Jose, CA, January 1999.
- K1998.3 "Reconstruction of the Atanasoff-Berry Computer," *International Conference on the History of Computing*, Paderborn, Germany, August 1998.
- K1998.2 "Making Computer Design a Science Instead of an Art," *HPCS '98*, Edmonton, Alberta, Canada, May 1998.
- K1998.1 "Distributed Computer Performance Prediction," *National Center for Supercomputing Applications Seminar Series*, Champaign-Urbana, Illinois, April 1998.
- K1997.3 "Cluster Computing," *Sixth IEEE International Symposium on High Performance Distributed Computing*, Portland, Oregon, August 1997.
- K1997.2 "Forgotten Aspects of Computer Performance," *Parallel and Distributed Computing Techniques and Applications (PDPTA '97)*, Las Vegas, Nevada, July 1997.
- K1997.1 "The Program of Grand Challenge Problems: Expectations and Results," *Second Aizu International Symposium on Parallel Algorithms/Architecture Synthesis*, Aizu-Wakamatsu, Japan, March 1997.
- K1996.4 "Perspectives on Parallel Performance Metrics," *NATO Advanced Research Workshop in High Performance Computing: Technology & Applications*, Cetraro, Italy, June 24, 1996.
- K1996.3 "Can We Make Software that Lasts Fifty Years?" *NATO Advanced Research Workshop in High Performance Computing: Technology & Applications*, Cetraro, Italy, June 25, 1996.
- K1996.2 "A New Approach to Computer Performance Prediction," *Parallel Optimization Colloquium – POC '96*, Laboratoire PRISM, Université de Versailles, Versailles, France, March 1996.
- K1996.1 "Difficulties in Measuring and Reporting Parallel Performance," *INFORMS CSTS Conference*, Dallas, Texas, January 1996.
- K1995.3 "Broad-Spectrum Performance Analysis," *International Workshop on Computer Performance Measurement and Analysis (PERMEAN '95)*, Beppu, Japan, August 1995.
- K1995.2 "Evaluating Parallel Computer Performance," *University of Iowa Computer Aided Engineering Network*, Iowa City, Iowa, May 1995.
- K1995.1 "HINT: A New Way to Evaluate Computer Performance," *Caltech Symposium Series*, Pasadena, California, April 1995.



- K1994.3 "Parallel Computer Performance Evaluation," *Michigan State University Lecture Series*, East Lansing, Michigan, October 1994.
- K1994.2 "Experiences with the MasPar," *Parallel Processing Mini-Workshop*, Western University of London, Ontario, Canada, September 1994.
- K1994.1 "A Paradigm for Grand Challenge Performance Evaluation," *Mardi Gras Conference on Teraflop Computing and Grand Challenge Applications*, Baton Rouge, Louisiana, February 1994.
- K1993.2 "Evaluating Parallel Computer Performance," International Symposium in Mexico City, Mexico, November 1993.
- K1993.1 "Parallel Performance Evaluation... And What the Vendors Won't Tell You," *Ford Motor Corporation Technical Symposium*, Dearborn, Michigan, March 1993. Also at MRJ Inc. Technical Symposium, McLean, Virginia, March 1992.
- K1992.1 "The Consequences of Fixed-Time Performance Measurement," *Army High Performance Computing Research Center Colloquium Series*, Minneapolis, Minnesota, February 1992. Also at The Twenty-Sixth Hawaii International Conference on System Sciences, Kauai, Hawaii, January 1992.
- K1991.3 "Parallel Performance Evaluation," Northern Illinois University, Seminar Series, DeKalb, Illinois, October 1991.
- K1991.2 "Compute Intensive Applications On Advanced Computer Architectures," Queen Mary and Westfield College, University of London, London England, September 1991.
- K1991.1 "Computing Research at Ames Laboratory," *Boeing Computer Services Presentation Series*, Huntsville, Alabama, June 1991.
- K1990.2 "SLALOM: The First Scalable Computer Benchmark," Northern Illinois University, Seminar Series, DeKalb, Illinois, November 1990.
- K1990.1 "Ray Tracing and Radiosity on Massively Parallel Computers," Aizu, Japan, August 1990.
- K1988.1 "Parallel Applications on a 1024-Processor Hypercube," *Oregon Graduate Institute Lecture Series*, Beaverton, Oregon, April 1988.

## REFEREED AND CITED PUBLICATIONS, PER GOOGLE SCHOLAR (132)

- 2022.3 M. Bärthel, J. Rust, J. Gustafson, and S. Paul, "Improving the Precision of SORN Arithmetic by Introducing Fused Operations," *2022 IEEE International Symposium on Circuits and Systems (ISCAS)*, May 2022, pp. 258–262.
- 2022.2 C. Jugade, D. Ingole, D.-N. Sonawane, M. Kvasnica, and J. Gustafson, "A Memory-Efficient FPGA Implementation of Offset-Free Explicit Model Predictive Controller," *IEEE Transactions on Control Systems Technology*, May 2022.
- 2022.1 N.-M. Ho, H. De Silva, J. Gustafson, W.-F. Wong, "Qtorch+: Next Generation Arithmetic for Pytorch Machine Learning," *Conference on Next-Generation Arithmetic 2022 (CoNGA)*, March 2022, pp. 31–49.  
[https://link.springer.com/chapter/10.1007/978-3-031-09779-9\\_3](https://link.springer.com/chapter/10.1007/978-3-031-09779-9_3)
- 2021.4 V. Saxena, A. Reddy, J. Neudorfer, J. Gustafson, S. Nambiar, R. Leupers, and F. Marchant, "Brightening the Optical Flow through Posit Arithmetic," *2021 22<sup>nd</sup> International Symposium on Quality Electronic Design (ISQED)*, April 2021, pp. 463–468.
- 2021.3 N.-M. Ho, D. Nguyen, H. De Silva, J. Gustafson, W.-F. Wong, and I.-J. Chang, "Posit Arithmetic for the Training and Deployment of Generative Adversarial Networks," *2021 Design, Automation, and Test in Europe Conference & Exhibition (DATE)*, February 2021, pp. 1350–1355.
- 2021.2 H. Langroudi, V. Karia, Z. Carmichael, A. Ziyarah, T. Pandit, J. Gustafson, and D. Kudithipudi, "Alps: Adaptive Quantization of Deep Neural Networks with Generalized Posits," *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 2021, pp. 3100–3109.  
[https://openaccess.thecvf.com/content/CVPR2021W/ECV/html/Langroudi\\_ALPS\\_Adaptive\\_Quantization\\_of\\_Deep\\_Neural\\_Networks\\_With\\_Generalized\\_PositS\\_CVPRW\\_2021\\_paper.html](https://openaccess.thecvf.com/content/CVPR2021W/ECV/html/Langroudi_ALPS_Adaptive_Quantization_of_Deep_Neural_Networks_With_Generalized_PositS_CVPRW_2021_paper.html)
- 2021.1 J. Lim, M. Aanjaneya, J. Gustafson, and S. Nagarakatte, "An Approach to Generate Correctly-Rounded Math Libraries for New Floating-Point Variants," *Proceedings of the ACM on Programming Languages*, January 2021.  
<https://par.nsf.gov/biblio/10273626>
- 2020.4 C. Jugade, D. Ingole, D. Sonawane, M. Kvasnica, and J. Gustafson, "A Framework for Embedded Model Predictive Control Using Posits," *2020 59<sup>th</sup> IEEE Conference on Decision and Control (CDC)*, December 2020, pp. 2509–2514.
- 2020.3 J. Lim, M. Aanjaneya, J. Gustafson, and S. Nagarakatte, "A Novel Approach to Generate Correctly-Rounded Math Libraries for New Floating-Point Representations," arXiv preprint. <https://arxiv.org/abs/2007.05344>
- 2020.2 A. Guntoro, C. De La Parra, F. Merchant, F. De Dinechin, J. Gustafson, M. Langhammer, R. Leupers, and S. Nambiar, "Next-Generation Arithmetic for Edge Computing," *2020 Design, Automation, and Test in Europe Conference & Exhibition (DATE)*, March 2020, pp. 1357–1365. <https://past.date-conference.com/proceedings-archive/2020/pdf/1013.pdf>
- 2020.1 H. Langroudi, V. Karia, J. Gustafson, and D. Kudithipudi, "Adaptive Posit: Parameter-Aware Numerical Format for Deep Learning Inference on the Edge," *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops*, 2020, pp. 726–727.  
[https://openaccess.thecvf.com/content/CVPRW\\_2020/html/w40/Langroudi\\_Adaptive\\_Posit\\_Parameter\\_Aware\\_Numerical\\_Fo\\_rmat\\_for\\_Deep\\_Learning\\_Inference\\_CVPRW\\_2020\\_paper.html](https://openaccess.thecvf.com/content/CVPRW_2020/html/w40/Langroudi_Adaptive_Posit_Parameter_Aware_Numerical_Fo_rmat_for_Deep_Learning_Inference_CVPRW_2020_paper.html)
- 2019.4 C. Jugade, D. Ingole, D. Sonawane, M. Kvasnica, and J. Gustafson, "A Memory-Efficient Explicit Model Predictive Control Using Posits," *2019 Sixth Indian Control Conference (ICC)*, December 2019, pp. 188–193.



- 2019.3 H.F. Langroudi, Z. Carmichael, J.L. Gustafson, and D. Kudithipudi, "PositNN Framework: Tapered Precision Deep Learning Inference for the Edge," *2019 IEEE Space Computing Conference (SCC)*, July 2019, pp. 53–59. <https://arxiv.org/pdf/1812.01762.pdf>
- 2019.2 Z. Carmichael, H.F. Langroudi, C. Khazanov, J. Lillie, J.L. Gustafson, D. Kudithipudi, "Deep Positron: A Deep Neural Network Using the Posit Number System," *2019 Design, Automation & Test in Europe Conference & Exhibition (DATE)*, March 2019, pp. 1421–1426. <https://arxiv.org/pdf/1812.01762.pdf>
- 2019.1 Z. Carmichael, H.F. Langroudi, C. Khazanov, J. Lillie, J.L. Gustafson, D. Kudithipudi, "Performance-Efficiency Trade-off of Low-Precision Numerical Formats in Deep Neural Networks," *Proceedings of the Conference for Next-Generation Arithmetic 2019 (CoNGA)*, March 2019. DOI: 10.1145/3316279.3316282. <https://arxiv.org/pdf/1903.10584.pdf>
- 2018.3 H. De Silva, J. Gustafson, W.F. Wong, "Making Strassen Matrix Multiplication Safe," *Conference on High Performance Computing (HIPC)*, IEEE, December 2018, pp. 173–182. <https://ieeexplore.ieee.org/document/8638088>.
- 2018.2 H. Langroudi, Z. Carmichael, J. Gustafson, and D. Kudithipudi, "PositNN: Tapered Precision Deep Learning Inference for the Edge," October 2018. <https://openreview.net/pdf?id=HJGh64Vfo7>
- 2018.1 R. Chaurasiya, J.L. Gustafson, R. Shrestha, J. Neudorfer, S. Nambiar, K. Niyogi, F. Merchant, R. Leupers, "Parameterized Posit Arithmetic Hardware Generator," *2018 IEEE 36th International Conference on Computer Design (ICCD)*, 334–341, October 2018. DOI: 10.1109/ICCD.2018.00057.
- 2017.3 J. Gustafson, "Posit Arithmetic," October 2017. <https://www.posithub.org/docs/Posits4.pdf>
- 2017.2 D. Ingole, M. Kvasnica, H. De Silva, and J. Gustafson, "Reducing Memory Footprints in Explicit Model Predictive Control using Universal Numbers," *IFAC-PapersOnLine*, Vol. 50, Issue 1, pp. 11595–11600, <https://doi.org/10.1016/j.ifacol.2017.08.1518>.
- 2017.1 J. Gustafson and I. Yonemoto, "Beating Floating Point at its own Game: Posit Arithmetic," *Supercomputing Frontiers and Innovations*, Vol. 4, Number 2, August 2017. <https://www.superfri.org/index.php/superfri/article/view/137>
- 2016.4 N. Brummel, J. Gustafson, A. Klofas, C. Maltzahn, and A. Shewmaker, "Unum Arithmetic: Better Math with Clearer Tradeoffs," *International Workshop on Post Moore's Era Supercomputing*, November 2016. <https://users.soe.ucsc.edu/~carlosm/dev/publication/brummell-pmes-16/brummell-pmes-16.pdf>
- 2016.3 W. Tichy and J. Gustafson, "Unums 2.0: An Interview with John Gustafson," *Ubiquity*, Vol. 2016, Issue September, pp. 1–14. <http://ubiquity.acm.org/article.cfm?id=3001758>.
- 2016.2 J. Gustafson, "A Radical Approach to Computation with Real Numbers," *Supercomputing Frontiers and Innovations*, Vol. 3, Number 2, August 2016, pp. 38–53. <http://superfri.org/superfri/article/view/94>
- 2016.1 W. Tichy and J. Gustafson, "The End of (Numeric) Error: An Interview with John Gustafson," *Ubiquity*, Vol. 2016, Issue April, pp. 1–14. <http://ubiquity.acm.org/article.cfm?id=2913029>
- 2015.1 J. Gustafson, "The End of Numerical Error," *ARITH-23*, <http://arith22.gforge.inria.fr/slides/06-gustafson.pdf>, June 2015.
- 2014.1 J. Gustafson, "An Energy-Efficient and Massively Parallel Approach to Valid Numerics," <https://www.uni-wuerzburg.de/fileadmin/10030000/scan2014/bookOfAbstracts.pdf#page=63>, September 2014.
- 2011.5 J. Gustafson, "Moore's Law," *Encyclopedia of Parallel Computing*, Springer, 2011, pp. 1177–1184.
- 2011.4 J. Gustafson, "Little's Law," *Encyclopedia of Parallel Computing*, Springer, 2011, pp. 1038–1041.
- 2011.3 J. Gustafson, "Gustafson's Law," *Encyclopedia of Parallel Computing*, Springer, 2011, pp. 819–825.
- 2011.2 J. Gustafson, "Amdahl's Law," *Encyclopedia of Parallel Computing*, Springer, 2011, pp. 53–60.
- 2011.1 J. Gustafson, "Brent's Theorem," *Encyclopedia of Parallel Computing*, Springer, 2011, pp. 182–185.
- 2010.1 J. Gustafson, "Challenges and Future Directions of Software Technology: The Need for Explicit Programming Environments," *Computer Software and Applications Conference (COMPSAC)*, IEEE Press, July 2010, pp. 8–9.
- 2008.1 J. Gustafson and P. Gustafson, "Method and Apparatus for Accuracy-Aware Analysis," *US Patent 7448026*, November 2008.
- 2007.1 J. Gustafson, "Acceleration Technology for High-Performance Computing in China," *China HPC*, November 2007, pp. 67–70.
- 2006.1 J. Gustafson, "The Quest for Linear Solvers and the Invention of Electronic Digital Computing," *Proceedings of the JVA 2006 International Symposium on Computing*, Sofia, Bulgaria, October 2006, pp. 10–16.
- 2004.3 S. Faulk, J. Gustafson, P. Johnson, A. Porter, W. Tichy, L. Votta, "Measuring High-Performance Computing Productivity," *International Journal of High-Performance Computing Applications*, Vol. 18, Issue 4 (November 2004), pp. 459–473.
- 2004.3 S. Faulk, J. Gustafson, P. Johnson, A. Porter, W. Tichy, L. Votta, "Toward Accurate HPC Productivity Measurement," *International Journal of High-Performance Computing Applications*, May 2004, pp. 42–46.
- 2004.2 J. Gustafson, "Purpose-Based Benchmarks," *International Journal of High-Performance Computing Applications*, Vol. 18, Issue 4 (November 2004), pp. 475–487.
- 2004.1 J. Gustafson, "The Speed of Light Isn't What It Used to Be," *Proceedings of Parallel and Distributed Systems (ICPADS) 2004*, IEEE Press, July 2004.
- 2003.2 J. Gustafson, "Sun's HPCS Approach: Hero," *Coalition for Academic Scientific Publication (CASC)*, 2003.
- 2003.1 J. Gustafson, "Atanasoff-Berry Computer," entry in *Encyclopedia of Human-Computer Interaction*

- 2002.1 J. Gustafson, "Asymptotic Formulas for Elliptic Integrals," Iowa State University, February 2002.
- 2001.5 J. Gustafson, "John V. Atanasoff," *Encyclopedia of Computers and Computer History*, R. Rojas, Ed., Fitzroy Dearborn Publishers, 2001.
- 2001.4 J. Gustafson, "Hypercube Architecture," *Encyclopedia Computers and Computer History*, R. Rojas, Ed., Fitzroy Dearborn Publishers, 2001.
- 2001.3 J. Gustafson, "Cray-1," *Encyclopedia of Computers and Computer History*, R. Rojas, Ed., Fitzroy Dearborn Publishers, 2001.
- 2001.2 J. Gustafson, "Atanasoff-Berry Computer," *Encyclopedia of Computers and Computer History*, R. Rojas, Ed., Fitzroy Dearborn Publishers, 2001.
- 2001.1 J. Gustafson, "The Mainstreaming of Interval Arithmetic," chapter in *Perspectives on Enclosure Methods*, U. Kulisch, R. Lohner, A. Facius, eds., Springer-Verlag, 2001, pp. 105–117.
- 2000.2 J. Gustafson, "Reconstruction of the Atanasoff-Berry Computer," *The First Computers: History and Architectures*, MIT Press, July 2000, pp. 91–106.
- 2000.1 R. Todi, G. Prabhu, Y. Alexeev, and J. Gustafson, "Evaluation of File Access Patterns using Realistic I/O Workloads for a Cluster Environment," *Parallel Computing: Fundamentals and Applications* (book), World Scientific, 2000, pp. 689–696.
- 1999.3 J. Gustafson and R. Todi, "Operations are Free; Data Motion Isn't," *IEEE Computer*, Vol. 32, Issue 12, December 1999, p. 4.
- 1999.2 J. Gustafson, D. Heller, R. Todi, and J. Hsieh, "Cluster Performance: SMP versus Uniprocessor Nodes," *Proceedings of Supercomputing '99*, (CD-ROM), ACM SIGARCH, November 1999.
- 1999.1 J. Gustafson, R. Benner, and G. Montry, "Methods for Operating Parallel Computing Systems Employing Sequenced Communications," *US Patent 5935216*, August 1999.
- 1998.7 S. Aluru, J. Gustafson, G. Prabhu, and F. Sevilgen, "Distribution-Independent Hierarchical Algorithms for the  $N$ -body Problem," *The Journal of Supercomputing*, October 1998, pp. 303–323.
- 1998.6 J. Gustafson, "Making Computer Design a Science instead of an Art," *High Performance Computing Systems and Applications*, Springer, 1998, pp. 3–14.
- 1998.5 J. Gustafson, "Reconstruction of the Atanasoff-Berry Computer," *Annals of the History of Computing*, August 1998.
- 1998.4 R. Todi, J. Gustafson, "Application Signature: An Analytic Technique to Model System Performance," <http://citeseerx.ist.psu.edu/viewdoc/download>, 1998.
- 1998.3 J. Gustafson, "Making Computer Design a Science Instead of an Art," *Proceedings of the 12<sup>th</sup> Annual Canadian Conference on Computing Systems and Applications*, Edmonton, 1998.
- 1998.2 J. Gustafson, "Computational Verifiability of the ASCI Program," *IEEE Computational Science & Engineering*, March–June 1998, pp. 36–45.
- 1998.1 J. Gustafson and R. Todi, "Conventional Benchmarks as a Sample of the Performance Spectrum," *Proceedings of the Thirty-first Hawaii International Conference on System Sciences*, January 1998. Also in *The Journal of Supercomputing*, Vol. 13, No. 3, May 1999, pp. 321–342.
- 1997.4 "The Mainstreaming of Parallel Computation," *Communications of the ACM*, Vol. 40, Issue 11, November 1997, pp. 25–26.
- 1997.3 Q. Snell and J. Gustafson, "Parallel Hierarchical Global Illumination," *Proceedings of the Sixth IEEE International Symposium on High Performance Distributed Computing*, August 1997, pp. 12–19.
- 1997.2 J. Gustafson "Distributed Means Clusters, Networks—and NT?" *IEEE Computational Science & Engineering*, July–September 1997, p. 87.,
- 1997.1 J. Gustafson, "The Program of Grand Challenge Problems: Expectations and Results," *Proceedings of the Second Aizu International Symposium on Parallel Algorithms/Architecture Synthesis*, March 1997, pp. 2–7.
- 1996.5 Q. Snell, A. Mikler, and J. Gustafson, "NetPIPE: A Network Protocol-Independent Performance Evaluator," IASTED, 1996.
- 1996.4 J. Gustafson, "A New Approach to Computer Performance Prediction," *Proceedings of the Parallel Optimization Conference*, Versailles, France, March 1996.
- 1996.3 Q. Snell and J. Gustafson, "An Analytical Model of the HINT Performance Metric," *Proceedings of Supercomputing '96*, Pittsburgh, Pennsylvania, IEEE Press, November 1996, pp. 54–61.
- 1996.2 Q. Snell, A. Mikler, and J. Gustafson, "NetPIPE: A Network Protocol-Independent Performance Evaluator," *Proceedings of the International Conference on Intelligent Information Management Systems*, Washington D.C., June 5–7, 1996.
- 1996.1 J. Gustafson and S. Aluru, "Massively Parallel Searching for Better Algorithms or How to do a Cross Product in Five Multiplications," *Journal of Scientific Programming*, Vol. 17 (3), March 1996, pp. 203–217.
- 1995.1 J. Gustafson and Q. Snell "HINT: A New Way to Measure Computer Performance," *Proceedings of the Twenty-Eighth Hawaii International Conference on System Sciences*, January 1995, pp. 392–401.
- 1994.4 S. Aluru, J. Gustafson, and G. Prabhu, "Truly Distribution-Independent Algorithms for the  $N$ -body Problem," *Proceedings of Supercomputing '94*, Washington, D.C. November 1994.
- 1994.3 B. Carlson and J. Gustafson, "Asymptotic Approximations for Symmetric Elliptic Integrals," *SIAM Journal on Mathematical Analysis*, Vol. 25, No. 2, March 1994.
- 1994.2 J. Gustafson, "A Paradigm for Grand Challenge Performance Evaluation," *Proceedings of the Toward Teraflop Computing and New Grand Challenge Applications Mardi Gras Conference*, Nova Science Publishers, 1995, pp. 279–290.



- 1994.1 J. Gustafson, "Teraflops and Other False Goals," *IEEE Parallel & Distributed Technology: Systems & Applications*, Vol. 2, Issue 2, 1994, pp. 5–6.
- 1993.6 J. Gustafson, "Method and System for Benchmarking Computers," *US Patent 5245638*, September 1993.
- 1993.5 J. Gustafson and S. Aluru, "Subtle Issues of SIMD Tree Search," *ParCo '93 Proceedings*, Grenoble, France, September 1993.
- 1993.4 J. Gustafson and S. Aluru, "A Massively Parallel Optimizer for Expression Evaluation," *Proceedings of the ACM International Conference on Supercomputing (7th ICS '93)*, ACM Press, July 1993, pp. 97–106.
- 1993.3 X.-H. Sun and J. Gustafson, "Toward a Better Parallel Performance Metric," *Computer Benchmarks*, J. Dongarra and W. Gentzsch, Editors, Elsevier Science Publishers B.V., 1993.
- 1993.2 J. Gustafson, "The 'Tar Baby' of Computing: Performance Analysis," *ORSA Journal on Computing*, Vol. 5, No. 1, February 1993, pp. 19–21.
- 1993.1 M. Wikstrom and J. Gustafson, "The Twin Bottleneck Effect," *Proceedings of the Twenty-Sixth Annual Hawaii International Conference on System Sciences*, January 1993, pp. 574–583.
- 1992.6 J. Gustafson and S. Aluru, "Massively Parallel Searching for Better Algorithms," *IS-5088*, Ames Laboratory, December 1992.
- 1992.5 J. Gustafson, "MPP: All Things Considered, Is It More Cost-Effective?" *Proceedings of Frontiers '92: The Fourth Symposium on the Frontiers of Massively Parallel Computation*, October 1992.
- 1992.4 S. Aluru and J. Gustafson, "A Random Number Generator for Parallel Computers" *Parallel Computers*, Vol. 18, 1992, pp. 839–847.
- 1992.3 D. Hoffman, D. Kouri, J. Gustafson, N. Nayar, and G. Prabhu, "Towards a Better Algorithm for Wave Propagation on Distributed Memory Machines," *Parallel Computing '91*, North-Holland, 1992.
- 1992.2 J. Gustafson, "The Vector Gravy Train," *Supercomputing Review*, June 1992.
- 1992.1 J. Gustafson, "The Consequences of Fixed Time Performance Measurement," *Proceedings of the Twenty-Fifth Hawaii International Conference on System Sciences*, January 1992.
- 1991.15 J. Gustafson, R. Benner, G. Montry, "Method for Simultaneous Communications between Neighboring Processors in a Multiple," *US Patent 5072371*, December 1991.
- 1991.14 M. Wikstrom, J. Gustafson, and G. M. Prabhu, "A Meta-Balancer for Dynamic Load Balancers," Iowa State University, 1991.
- 1991.13 X.-H. Sun and J. Gustafson, "Toward a Better Parallel Performance Metric," *Parallel Computing*, Vol. 17, Issue 10–11, pp. 1093–1109, December 1991.
- 1991.12 J. Gustafson, D. Rover, S. Elbert, and M. Carter, "SLALOM: Surviving Adolescence," *Supercomputing Review*, December 1991.
- 1991.11 M. B. Carter, N. Nayar, J. Gustafson, D. Hoffman, D. Kouri, and O. Sharafeddin, "When 'Grain Size' Doesn't Matter," *Proceedings of the Sixth Distributed Memory Computing Conference*, IEEE Press, 1991, pp. 579–586.
- 1991.10 D. Rover, M. B. Carter, and J. Gustafson, "Performance Visualization of SLALOM," *Proceedings of the Sixth Distributed Memory Computing Conference*, IEEE Press, 1991, pp. 543–550.
- 1991.9 D. Rover, V. Tsai, Y.-S. Chow, and J. Gustafson, "Signal Processing Algorithms on Parallel Architectures: A Performance Update," *Journal of Parallel and Distributed Computing: Special Issue on Massively Parallel Computation*, Vol. 13, No. 2, October 1991, pp. 237–247.
- 1991.8 X.-H. Sun and J. Gustafson, "Sizeup: A New Parallel Performance Metric," *International Conference on Parallel Processing*, Vol. 2: Software (ICPP '91), August 1991, pp. 289–299.
- 1991.7 J. Gustafson, "Compute-Intensive Applications on Advanced Computer Architectures," *Proceedings of the 1991 International Conference on Parallel Processing*, August 1991.
- 1991.6 M. Wikstrom, J. Gustafson, and G. Prabhu, "A Threshold Test for Dynamic Load Balancers," *Proceedings of the 1991 International Conference on Parallel Processing*, CRC Press, August 1991.
- 1991.5 J. Gustafson, D. Rover, S. Elbert, and M. Carter, "SLALOM: Is Your Computer on Our List?" *Supercomputing Review*, July 1991, pp. 52–59.
- 1991.4 J. Gustafson, D. Rover, and M. Carter, "Performance Visualization of SLALOM," *Sixth Distributed Memory Computing Conference*, IEEE Press, Portland, Oregon, August 1991, pp. 543–550.
- 1991.3 J. Gustafson, D. Rover, S. Elbert, and M. Carter, "The Design of a Scalable, Fixed-Time Computer Benchmark," *Journal of Parallel and Distributed Computing*, Vol. 12, No. 4, August 1991, pp. 388–401.
- 1991.2 D. Hoffman, O. Sharafeddin, D. Kouri, M. Carter, N. Nayar, and J. Gustafson, "On the Role of Parallel Architecture Supercomputers in Time-Dependent Scattering," *Theoretica Chimica Acta*, Springer-Verlag, Vol. 79, Issue 3–4, May 1991, pp. 297–311.
- 1991.1 J. Gustafson, "SLALOM: The Race Continues," *Supercomputing Review*, March 1991.
- 1990.4 J. Gustafson, D. Rover, S. Elbert, and M. Carter, "SLALOM: The First Scalable Supercomputer Benchmark," *Supercomputing Review*, November 1990. Also in *Parallelogram*, February 1991.  
<http://hint.byu.edu/pub/HINT/doc/Gus/SLALOM/FirstScalable.pdf>
- 1990.3 J. Gustafson, R. Benner, M. Sears, and T. Sullivan, "A Radar Simulation Program for a 1024-Processor Hypercube," *Japanese Journal of Computer Simulation*, August 1990.



- 1990.2 J. Gustafson, "Supercomputing in the Year 2000," *Supercomputing Review*, June 1990.
- 1990.1 J. Gustafson, "Fixed Time, Tiered Memory, and Superlinear Speedup," *Proceedings of the Fifth Distributed Memory Computing Conference (DMCC5)*, Vol. II, April 1990, pp. 1255–1260.
- 1989.8 M. Sears, R. Benner, and J. Gustafson, "A Radar Simulation Program for a 1024 Node Hypercube," *Proceedings of the 4th Conference on Parallel Processing for Scientific Computing*, SIAM Publishers, December 1989,
- 1989.7 J. Gustafson, "Are Parallel Computers 'Special Purpose'?" *Supercomputing Review*, December 1989.
- 1989.6 J. Gustafson, R. Benner, M. Sears, and T. Sullivan, "A Radar Simulation Program for a 1024-Processor Hypercube," *Supercomputing '89 Proceedings*, November 1989, pp. 96–105.
- 1989.5 J. Gustafson, G. Montry, and R. Benner, "A Structural Analysis Algorithm for Massively Parallel Computers," Chapter 10, *Parallel Supercomputing: Methods, Algorithms, and Applications*, G. Carey, Editor, J. Wiley & Sons, 1989, pp. 207–222.
- 1989.4 J. Gustafson, "Bridging the Gap Between Amdahl's Law and Sandia-Laboratory Result," *Communications of the ACM*, Vol. 32, Issue 8, August 1989, pp. 1015–1016.
- 1989.3 J. Gustafson and K. Dragon, "A Low-Cost Hypercube Load-Balancing Algorithm," *Proceedings of the Fourth Conference on Hypercubes, Concurrent Computers, and Applications*, IEEE, March 1989, pp. 583–589.
- 1989.2 J. Gustafson, "The Challenges to Parallel Processing," *High Performance Systems*, Vol. 10, Issue 2, February 1989, pp. 22–22.
- 1989.1 J. Gustafson, "Compute-Intensive Processors," chapter for *Parallel Processing for Supercomputers & Artificial Intelligence*, K. Hwang and D. DeGroot, Editors, McGraw-Hill, 1989, pp. 169–201.
- 1988.5 R. E. Benner, G. Montry, and J. Gustafson, "A Structural Analysis Algorithm for Massively Parallel Computers," SAND-88-3363C; CONF-8810280-2, Sandia National Labs, December 1988.
- 1988.4 J. Gustafson, G. Montry, and R. Benner, "Development of Parallel Methods for a 1024-Processor Hypercube," *SIAM Journal of Scientific and Statistical Computing*, Vol. 9, Number 4, July 1988, pp. 609–638.
- 1988.3 J. Gustafson and G. Montry, "Programming and Performance on a Cube-Connected Architecture," *COMPCON 1988 Proceedings*, 1988, pp. 97–100.
- 1988.2 J. Gustafson, "The Scaled-Size Model: A Revision of Amdahl's Law," *Proceedings of the Third International Conference on Supercomputing*, May 1988.
- 1988.1 J. Gustafson, "Reevaluating Amdahl's Law," *Communications of the ACM*, Vol. 31, May 1988, pp. 532–533.  
[https://www.researchgate.net/publication/220423283\\_Reevaluating\\_Amdahl's\\_Law](https://www.researchgate.net/publication/220423283_Reevaluating_Amdahl's_Law)
- 1987.1 J. Gustafson, "Increasing Hypercube Communications on Low-Dimensional Problems," *Hypercube Multiprocessors 1987*, M. Heath, Editor, SIAM Publications, 1987, pp. 244–250.
- 1986.6 J. Gustafson, S. Hawkinson, and K. Scott, "The Architecture of a Homogeneous Vector Supercomputer," *Journal of Parallel and Distributed Computing*, Vol. 3, No. 3, September 1986, pp. 297–304.
- 1986.5 J. Gustafson, "A Language-Independent Set of Benchmarks for Parallel Processors," *Proceedings of 25<sup>th</sup> Annual Lake Arrowhead Workshop on Frontiers and Limitations of High-Performance Computing*, <http://hint.byu.edu/pub/hint/doc/gus/6-pack/6-pack.pdf>, April 1986.
- 1986.4 J. Gustafson, "Evaluating Two Massively-Parallel Machines," *Communications of the ACM*, August 1986.
- 1986.3 A. Charlesworth and J. Gustafson, "Introducing Replicated VLSI to Supercomputing: The FPS-164/MAX Scientific Computer," *IEEE Computer*, March 1986.
- 1986.2 J. Gustafson, "Programming the FPS T Series" *Checkpoint*, FPS Journal March 1986, pp. 2–8.
- 1986.1 J. Gustafson, "Subdivision of PDEs on FPS Scientific Computers," *Communications in Applied Numerical Methods*, Vol. 2, Issue 3, May 1986, pp. 305–310.
- 1985.3 M. Heinrich and J. Gustafson, "Memory-Mapped VLSI and Dynamic Interleave Improve Performance," *Computer Design*, November 1985.
- 1985.2 J. Gustafson, "First Electronic Digital Calculating Machine Forerunner to Cornell's FPS-164/MAX," *Forefronts, Center for Theory and Simulation in Science and Engineering*, Cornell University, Vol. 1, Issue 6, October 1985.
- 1985.1 B. Carlson and J. Gustafson, "Asymptotic Expansion of the First Elliptic Integral," *SIAM Journal of Mathematical Analysis*, Vol. 16, Number 5, September 1985, pp. 1072–1092.
- 1983.1 B. Carlson and J. Gustafson, "Total Positivity of Mean Values and Hypergeometric Functions," *SIAM Journal of Mathematical Analysis*, Vol. 14, Number 2, March 1983, pp. 389–395.
- 1982.1 J. Gustafson, "Asymptotic Formulas for Elliptic Integrals," Ph.D. Dissertation, Iowa State University, August 1982.
- 1981.1 J. Gustafson, "Total Positivity of Hypergeometric Functions," M.S. Thesis, Iowa State University, May 1981.
- 1976.1 J. Gustafson, "A Fast-Convergence Infinite Product for the Gamma Function," *Notices of the American Mathematical Society*, May 1976.

## CITATION INDICES

According to Google Scholar as of December 3, 2022:

Citation indices	All	Since 2014
Citations	5928	1713
h-index	30	16
i10-index	57	29